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(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

(72)発明者　原田　豊
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　亀井　誠
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　地頭所　典行
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(74)代理人　弁理士　小鍜治　明　（外2名）

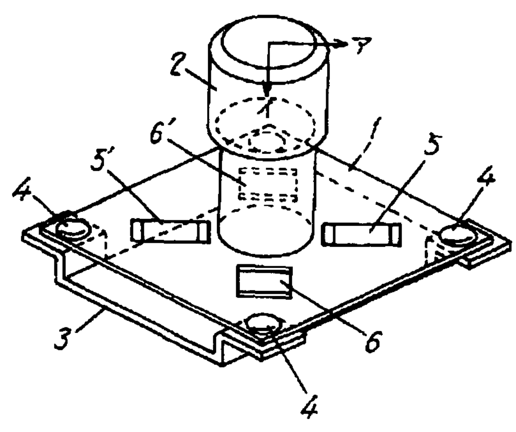
(54)【発明の名称】　荷重センサ

(57)【要約】

【目的】　ポインティングデバイスとして用いられる荷重センサに関するものであり、抵抗精度、コスト、量産性、信頼性、強靭性にすぐれた荷重センサを提供することを目的とするものである。

【構成】　周囲を4ヵ所固定されガラスホーロー被覆を設けた弾性板1にあって、弾性板1の中央に立てられた操作部2に加えた力により、弾性板1が変形し、この変形をホーロー上に直接形成された二対の歪み抵抗検出素子5、5′、6、6′の抵抗値変化で検知し、各一対の抵抗値変化の差を演算することにより、操作部の力の方向と大きさを検出するものである。

1 弾性板　2 操作部　3 取付台　4 固定部　5,5′ 第1の歪み抵抗検出素子　6,6′ 第2の歪み抵抗検出素子



【特許請求の範囲】

【請求項1】　端部に固定部を有する弾性板と、この弾性板の中央に配設された操作部と、前記弾性板上に設けられた少なくとも2つの歪み抵抗検出素子とからなる荷重センサ。

【請求項2】　中央に固定部を有する弾性板と、この弾性板の端部に設けた操作部と、前記弾性板上に少なくとも2つの歪み抵抗検出素子とからなる荷重センサ。

【請求項3】　L字状の弾性板と、この弾性板上に設けられたガラスホーロー被覆層と、前記弾性板の中央に立てられた操作部と、前記弾性板の中央の支持部と、前記弾性板を装着する支持部と、ホーロー上に直接形成された少なくとも2つの歪み抵抗検出素子とからなる荷重センサ。

【請求項4】　弾性板は支持部によって全方向に固定され、中央の支持部を回転可能であるが金属弾性板平面と垂直な動きを規制するピボット支持とする請求項3記載の荷重センサ。

【請求項5】　2つの歪み抵抗検出素子と対になる他の2つの歪み抵抗検出素子を、弾性板周囲の支持部より外側の延長部に配置したことを特徴とする請求項4記載の荷重センサ。

【請求項6】　弾性板の支持部は弾性板中央と周囲との支持部を結ぶ方向のみ可動とし、中央の支持部は回転可能であるが金属弾性板平面と垂直方向の動きを規制するピボット支持としたことを特徴とした請求項1または3記載の荷重センサ。

【請求項7】　歪み抵抗検出素子は、歪み感応抵抗体である請求項1，2または3記載の荷重センサ。

【請求項8】　弾性板は、圧電材料からなる基板、ガラスまたは樹脂の電気絶縁材料を少なくとも一部分をコーティングした金属板、ホーロー金属板、アルミナからなる基板、樹脂材料からなる基板または銅張積層板のいずれからなる請求項1，2または3記載の荷重センサ。

【請求項9】　二対の歪み抵抗検出素子を弾性板の同一表面上に有し、この二対の歪み抵抗検出素子に直交する線の対称位置に配置する請求項1，2または3記載の荷重センサ。

【請求項10】　二対の歪み抵抗検出素子を有し、各一対の歪み抵抗検出素子を弾性板の面対称になる表裏に配置する請求項1，2または3記載の荷重センサ。

【請求項11】　弾性板と連結してなる操作部の直径を、前記弾性板の幅より前記操作部の直径を大きくしてなる請求項4記載の荷重センサ。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、2次元の座標入力を行うポインティングデバイスに用いる荷重センサに関するものである。

【0002】

【従来の技術】近年、2次元の座標入力として、またパーソナル・コンピュータ（以下、「パソコン」と記す。）等のGUI（グラフィカル・ユーザー・インターフェイス）の操作入力装置として、ポインティングデバイスが重要な入力として注目されている。パソコンの小型・軽量化の流れからノートブックパソコンが広く使われるようになってきて、このポインティングデバイスの1つとして、「マウス」が広範に使用されている。しかしながら、ノートブックパソコンは机の上だけでなく、膝の上に置いたり、列車や飛行機などの座席等のマウスを操作するための平面を確保できない場所での使用が多くなり、マウスは使用上問題のあるポインティングデバイスになってきており、この課題を解決するために、荷重センサを用いたポインティングデバイスが開発されている。

【0003】以下に、従来の荷重センサを用いたポインティングデバイスについて説明する。図12は、従来の荷重センサを用いたポインティングデバイスの斜視図である。図12において、41は取付台である。42は取付台41の中央部に一体に設けられた4角柱状の軸で、上面は指で荷重を与える操作部43を有している。この軸42の側面は、対向する面と対になるように張り付けられた二対の第1、第2の歪みゲージ44、44′、45、45′を有し、操作部43に加えられた力で、軸42と垂直な分力により軸42が変形し、この変形に応じて、第1、第2の歪みゲージ44、44′、45、45′が収縮して、抵抗値が変化する。

【0004】つまり、第1、第2の歪みゲージ44、44′、45、45′は軸42の中心軸と対称な1組を一対としており、この二対の第1、第2の歪みゲージ44、44′、45、45′は90°の間隔に配設しているので、軸42の変形を2つの座標に分割することができる。実際には、第1の歪みゲージ44、44′の一対の歪みゲージの信号の差を取った信号を1座標軸方向の信号とし、第2の歪みゲージ45、45′も同様に差の信号を取り、他の座標軸の信号としている。

【0005】2つの座標軸の上記信号により、指が操作部43に与えた力の方向と大きさを検知して、CRT（図示せず）上のポインタを動かす信号となる。

【0006】

【発明が解決しようとする課題】上記従来の構成では、軸42に第1、第2の歪みゲージ44、44′、45、45′を接着しているので、接着する位置がずれると軸42の上面の操作部43に加えられた力に対する感度が変わりポインタの動く方向が変わるため、精度良く位置決めしなければならないと共に、接着時に第1、第2の歪みゲージ44、44′、45、45′を変形させないような接着方法を取る必要があるという課題を有していた。

【0007】さらに、軸42の対向する側面の第1、第

２の歪みゲージ４４、４４′、４５、４５′の抵抗値を同一にしておく必要があると共に、選別して使用しなければならずコストアップになり、組立が複雑になるという課題を有していた。

【０００８】本発明は、上記従来の課題を解決するもので、低コストで量産性に優れた荷重センサを提供することを目的とするものである。

【０００９】

【課題を解決するための手段】上記従来課題を解決するために、本発明は、端部に固定部を有する弾性板と、この弾性板の中央に配設された操作部と、前記弾性板上に設けられた少なくとも２つの歪み抵抗検出素子とからなるものである。

【００１０】また、中央に固定部を有する弾性板と、この弾性板の端部に設けた操作部と、前記弾性板上に少なくとも２つの歪み抵抗検出素子とからなるものである。

【００１１】

【作用】したがって、本発明によれば厚膜印刷等の方法で弾性板に直接歪み抵抗検出素子を形成することから、従来の技術のような接着による位置ずれがなく、一括して精度良く歪み抵抗検出素子が配置できる。

【００１２】また、金属板上のガラスホーロー被膜上に歪み抵抗検出素子を形成することから、相対抵抗精度が高くトリミングが容易で抵抗値の高制度化が可能であるものである。

【００１３】

【実施例】

（実施例１）以下に、本発明の一実施例における荷重センサを用いたポインティングデバイスについて説明する。

【００１４】図１は、本発明の一実施例における荷重センサを用いたポインティングデバイスの斜視図である。図１において、１は弾性板で、圧電材料からなる基板、ガラスまたは樹脂の電気絶縁材料を少なくとも一部分をコーティングした金属板、ホーロー金属板、アルミナからなる基板、樹脂材料からなる基板または銅張積層板のいずれからなるものである。２は弾性板１の略中央部にこの弾性板１と連結して設けられた操作部である。３は取付台で、弾性板１の周囲４ヵ所の端部である固定部４で固定され、操作部２を指で力を加えることにより、弾性板が変形する構造になっている。弾性板１上の操作部２と固定部４との間には、操作部２と対向する位置、つまり、弾性板１の同一表面上に固定部４と操作部２とを結ぶ線の直交する対称位置に抵抗値の等しい歪み感応抵抗体からなる第１、第２の歪み抵抗検出素子５、５′、６、６′が設けられている。

【００１５】以上のように構成された本発明の一実施例における荷重センサを用いたポインティングデバイスの動作について、以下に説明する。

【００１６】まず、操作部２を図１に示す弾性板１と平

行な「ア」の方向に力を加えた場合、弾性板１の第１の歪み抵抗検出素子５の部分は凹面に、第１の歪み抵抗検出素子５′の部分は凸面に変形する。この変形により、第１の歪み抵抗検出素子５の抵抗値は下がり、第１の歪み抵抗検出素子５′の抵抗値は上がる。この第１の歪み抵抗検出素子５、５′の一対の抵抗値変化の差を演算することで、抵抗値変化が２倍に拡大され、加えられた力を検出することができる。

【００１７】一方、第２の歪み抵抗検出素子６、６′は、同じ方向のねじり応力が加えられるだけで抵抗値変化は起こらない。つまり、第１の歪み抵抗検出素子５、５′上の座標軸方向のみの力が検出できる。

【００１８】次に、操作部２を図１に示す弾性板１と平行な「イ」の方向に力を加えた場合、弾性板１の第２の歪み抵抗検出素子６の部分は凹面に、第２の歪み抵抗検出素子６′の部分は凸面に、第１の歪み抵抗検出素子５、５′は同じ方向のねじり応力が加えられ、第２の歪み抵抗検出素子６、６′上の座標軸方向のみの力が検出できる。

【００１９】このように、操作部２に加えられた力は、２座標軸の方向に分離されて、方向と大きさが検出できるものである。

【００２０】（実施例２）図２は、本発明の実施例２における荷重センサを用いたポインティングデバイスで、実施例１と同様な構成は同一番号を付し、説明は省略する。実施例１と異なるところは、対になる第１の歪み抵抗検出素子５、５′および第２の歪み抵抗検出素子６、６′を弾性板１の表裏に配置したことである。本実施例２では、対になる第１、第２の歪み抵抗検出素子５、５′、６、６′は、弾性板の歪みに対して圧縮・伸張の変形を受け検出精度が向上するものである。

【００２１】（実施例３）図３は、本発明の実施例３における荷重センサを用いたポインティングデバイスで、実施例１と同様な構成は同一番号を付し、説明は省略する。実施例３は、実施例１の弾性板１の形状を変えたもので、弾性板７を操作部２を中心とした十字型とし、端部の４ヵ所を固定部４で固定したものである。本実施例４では、加えられた力に対する弾性板７の変形量が上述した実施例１、２よりも大きくなるので力に対する信号変化の感度が高くできるものであると共に、歪みが均等に発生しやすくなるため、第１、第２の歪み抵抗検出素子の位置精度に高精度が要求されず、生産性が高くなる。

【００２２】（実施例４）図４、図５は本発明の実施例４であり、８はガラスホーロー被覆が設けられたＬ字状の弾性板、２は操作部、９は取付台である。１３はピボット支持部で取付台９からの突起である。弾性板８の中央は操作部２と連結し、周囲の２ヵ所は取付台９の固定部１０で固定されている。また、弾性板８の中央は取付台９からのピボット支持部１３で支持されている。さら

に、弾性板８表面のガラスホーロー被覆面には１１，１２の第１、第２の歪み抵抗検出素子がグレーズ抵抗を印刷被膜して直接構成している。

【００２３】以下に、動作について説明すると、操作部２を図４上の「ウ」の方向（弾性板８と平行）に力を加えた場合、金属弾性板の第２の歪み抵抗検出素子１２の部分は凹面に変形する。一方１１の部分はピボット支持によりねじり変形をする。この第２の歪み抵抗検出素子１２の部分の変形により歪み抵抗検出素子は抵抗値が変化するが、第１の歪み抵抗検出素子１１はねじり応力が加えられるだけで抵抗値変化はない。次に操作部２を図４上の「エ」の方向（弾性板８と平行）に力を加えた場合、弾性板８の第１の歪み抵抗検出素子１１の部分は凹面に変形し、第２の歪み抵抗検出素子１２はねじり応力が加えられる。このように操作部２に加えられた力は２座標軸の方向に分離されて、方向と大きさが検出できる。

【００２４】また、本実施例４ではピボット１３の支持により垂直荷重を受けるので、正確に水平荷重のみを検出することができ、操作性の優れた荷重センサを用いたポインティングデバイスが提供できる。

【００２５】（実施例５）図６は歪み抵抗検出素子の他の配置例である。第１、第２の歪み抵抗検出素子１１、１２と対になる第１、第２の歪み抵抗検出素子１１′１２′は、弾性板１４を延ばした固定部１０の外側に配置している。この位置にある第１、第２の歪み抵抗検出素子１１′、１２′は弾性板１４が歪んでも影響を受けない。本実施例５では対になる第１の歪み抵抗検出素子１１、１１′および第２の歪み抵抗検出素子１２、１２′のそれぞれ抵抗変化の差を演算する。このことで歪み抵抗検出素子の温度変化をキャンセルすることができるものである。

【００２６】（実施例６）図７（ａ），（ｂ）は、本発明の実施例６であり、断面を示したものである。１５は弾性板、１６は支持台、１７は取付台、１８は操作部である。操作部１７と弾性板１５は一体で、操作部１８の中央最下部には円錐状の凹部１９を設けてある。支持台１６からは円錐状の突起であるピボット支持部２０を設け、操作部１８の凹部１９に当接している。このような支持であるから操作部１８は支持台１６の突起部２０の先端を中心として自由に回転できるが、操作部１８が支持台１６方向に押さえられても支持台１６のピボット支持部２０で支持されている。

【００２７】２１は支持台１６と取付台１７の弾性板１５周辺の支持部で弾性板１５をはさんでいるが、弾性板１５の厚みに対して適切なクリアランスをもたせてある。さらに弾性板１５と取付台１７の支持部２１は図７（ｂ）に示したように、弾性板１５には長円の孔をあけており、取付台１７から円柱状の突起が入り込んでいる。このような構造であるから弾性板１５は操作部１８の中央と支持部２１を結ぶ線上のみ自由にスライドすることができる。

【００２８】なお、弾性板１５には実施例５の弾性板１４上と同様に歪み抵抗検出素子が設けられているが図上は省略している。

【００２９】この実施例でも操作部１８先端に加えられた力によって弾性板１５が変形することは、他の実施例と同様で、荷重センサとしての機能を持つ。本実施例では弾性板１５の面と平行な方向での固定部は操作部１８の凹部１９のみであるから支持台１６・取付台１７の温度による膨張・収縮の影響を受けない構造になっている。

【００３０】（実施例７）図８は実施例４の図６の弾性板をＴ字状の弾性板２２として固定部１０のない第３のアーム部に歪み抵抗検出素子１１″、１２″を配置したものである。歪み抵抗検出素子１１″、１２″は応力を受けない事は実施例４と同様である。本実施例では配線パターン２２が固定部１０の近傍を通す必要がなくアーム部が細くできさらに小型化が可能となる。

【００３１】図９は図４、図５の本発明の荷重センサをフルキーボードのポインティングデバイスとして用いた応用例を示すものであり、２３はキートップ、２４はＳＷ素子、２５は実施例４，５の荷重センサである。各キートップ２３の下に破線で示したようにＳＷ素子２４が配置され、これらのＳＷ素子２４の間にハッチングで示した荷重センサ２５が設置されている。これから明らかなようにＬ字形状はセンサが大きくなってもキーの間にうまく配置できる特徴がある。Ｔ字形状も同じである。このためにポインティングデバイスを内蔵したノートパソコンのさらなる小型化に貢献できるものである。

【００３２】図１０は、本発明における荷重センサを用いたポインティングデバイスの実施例４～６における弾性板と軸と歪み抵抗検出素子との関係を示した図である。ここで実施例６のポインティングデバイスを例にして説明すると、操作部２に連結された弾性板２２の連結部の直径をＤとする。弾性板２２上の歪み抵抗検出素子１１、１２を配置したアーム部２２ａ，２２ｂの幅をＷとする。歪み抵抗検出素子１１、１２と操作部２中心までの距離をＨとする。

【００３３】この時、操作部２の「オ」の方向に水平荷重を加えると、弾性板２２の歪み抵抗検出素子１２を配したアーム部２２ａは曲げ応力を受ける。この時、操作部２は剛体であり、この剛体である操作部２に連結された弾性板２２に曲げ応力を加えると、操作部２と弾性板２２との境界部が最大の応力を受けるので、アーム部２２ａの中心軸と操作部２の外周との交点Ａが最大の応力を受けることとなる。この交点Ａは、Ｈ＝０．５Ｄである。

【００３４】一方、この時アーム部２２ｂはねじり応力を受けているのでひっぱり応力としてはアーム部２２ｂ

の中心軸は中性点で０であり、中心軸から離れるにしたがってひっぱり応力が大きくなり、アーム部２２ｂの中心軸上に配置することで、ねじり応力に対する歪みは最小となる。このような応力分布から歪み抵抗検出素子１１、１２をアーム部２２ａ，２２ｂの中心軸上でＨ＝０．５Ｄ付近に配置することで曲げ応力に対し最大で、かつ、ねじり応力に対して最小の信号が得られる。

【００３５】つまり長方形の弾性板にねじり応力を加えた場合中性点は長方形の弾性板の中心軸となるが、本実施例６ではＴ字状の弾性板２２の片側のアーム部２２ａにねじり応力が加えられているので、他方のアーム部２２ｂの曲げ応力の歪みの影響を受けて中心軸上が中性点とはならない。中性点を中心軸上にするために、剛体である操作部２の直径を太くして２つのアーム部２２ａ，２２ｂに歪みが伝わらないようにしてやれば良い。つまり、操作部２と弾性板２２との連結部の円周を、２つのアーム部２２ａ，２２ｂの外辺との交点（図１０のＢ点）と重なる直径以上にする。つまり、

【００３６】

【外１】

$$\sqrt{2W}$$

【００３７】とすることでねじり応力の影響を小さくして誤差信号が最小となる。このように歪み抵抗検出素子の位置と操作部２の直径とアーム部２２ａ，２２ｂの寸法を規定することで、操作部２に加えられた水平荷重を、誤差を最小にして二軸に分離することができる。

【００３８】（実施例８）図１１（ａ），（ｂ）は本発明における荷重センサを用いたポインティングデバイスの実施例８で図１１（ａ）は斜視図、図１１（ｂ）は断面図である。本実施例で２６が弾性板、２７は操作部、２８は取付台、２９は固定部である。弾性板２６は中心を取付台２８の固定部２９で固定され、操作部２７は弾性板周囲と連結されている。操作部２７先端を荷重「オ」のように力を加えられると、弾性板２６はその中心に対して力の方向に応力を加えられ変形する。本実施例８で図１～３の実施例と逆の構造となっており、弾性板２６の中心が固定で、周辺部に操作部２７からの荷重を受けている。

【００３９】本実施例８では操作部２７が弾性板２６に応力を加える位置（図１１（ｂ）のＬ）が実施例４～６より長くすることが可能である。操作部２７の先端は指先のあてる部分でその先端形状を操作し易い形状にするので樹脂成型品を使うことになる。本実施例８ではＬ寸法が長いので弾性板と結合された部分の応力が小さくなり、樹脂の変形が小さいので弾性板を変形させる作用点が安定しているため、温度による弾性板の変形量の変動が少なくなる。

【００４０】また、弾性板にホーロー金属板、もしくはガラスコート金属板を使うことにより、外部応力や衝撃に対して強靭であると共に、かしめ等の組立工法が使用

でき組立が容易となる。また高温処理が可能なことから抵抗体に高信頼性のメタルグレーズ抵抗体を使うことができる。

【００４１】

【発明の効果】本発明は、歪み抵抗検出素子を平面上に配置していることから、厚膜印刷等の方法で平面に歪み抵抗検出素子を形成することで、一括して精度よく歪み抵抗検出素子が配置でき、抵抗値の相対精度が高く、トリミングも容易で抵抗値の高精度化が可能である。特に一面だけ歪み抵抗体を形成した実施例ではこの特徴が顕著である。また、ガラスホーローを絶縁層とすることから、高温処理が可能で高信頼性なメタルグレーズ抵抗体を使うことができる。さらに金属弾性板を使用していることから外部応力や衝撃に対して強靭であることや、かしめ等の組立工法が使用でき組立が容易となる特徴がある。他の特徴としてガラスホーロー被覆上に厚膜ハイブリッド集積回路も構成できるものである。

【図面の簡単な説明】

【図１】本発明の荷重センサの一実施例の斜視図

【図２】同他の実施例の斜視図

【図３】同他の実施例の斜視図

【図４】同他の実施例の斜視図

【図５】同側面図

【図６】同他の実施例の斜視図

【図７】（ａ）同他の実施例の側断面図

（ｂ）同要部の上部断面図

【図８】同他の実施例の斜視図

【図９】本発明の荷重センサを用いたキーボードを説明する上面図

【図１０】同要部の平面図

【図１１】（ａ）同他の実施例の斜視図

（ｂ）同側面図及び断面図

【図１２】従来の荷重センサの斜視図

【符号の説明】

１，１５　弾性板

２，１８，２７　操作部

３，９，１７，２８　取付台

４，１０，２９　固定部

５，５′　第１の歪み抵抗検出素子

６，６′　第２の歪み抵抗検出素子

７，２６　十字形状の弾性板

８，１４　Ｌ字形状の弾性板

１１，１１′　第１の歪み抵抗検出素子

１１，１１″　第１の歪み抵抗検出素子

１２，１２′　第２の歪み抵抗検出素子

１２，１２″　第２の歪み抵抗検出素子

１３，２０　ピボット支持部

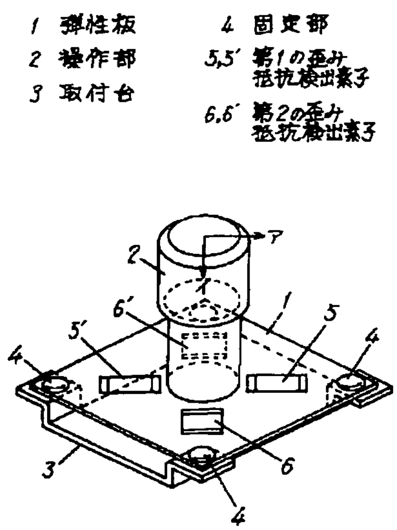
２１　スライド支持部

２２　Ｔ字形状の弾性板

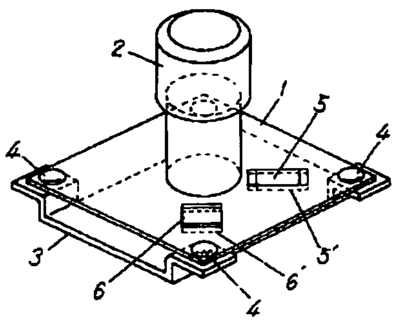
２３　キートップ

２４　キーボードのＳＷ素子
３１　断面が正方形の軸
３２，３２′　一対の歪みゲージ
３３，３３′　他の一対の歪みゲージ

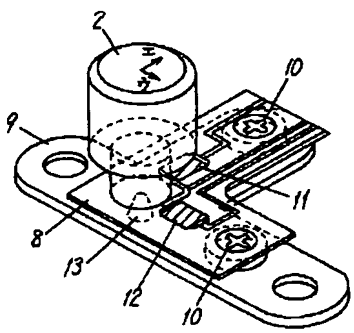
【図１】



【図２】



【図４】



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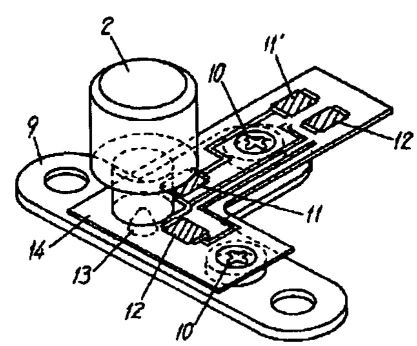
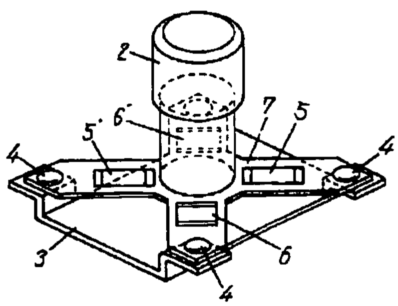
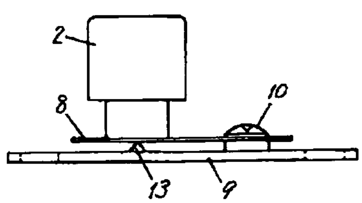


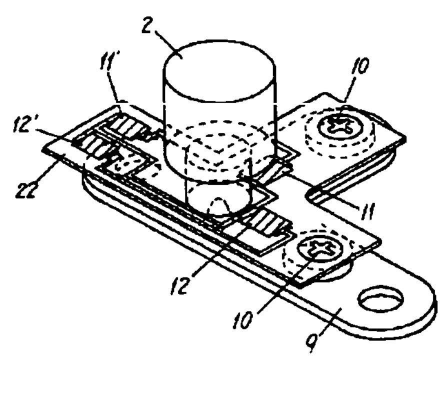
【図３】



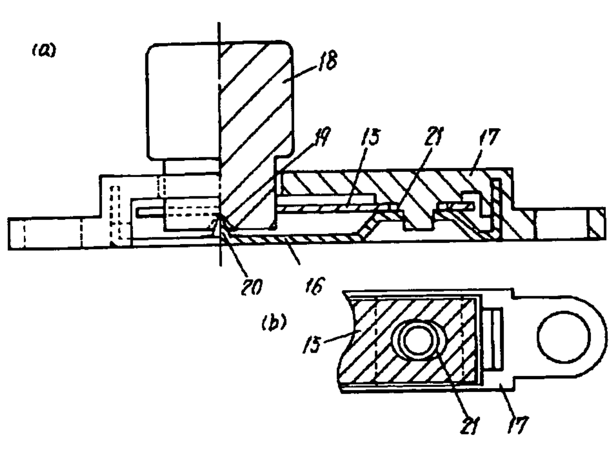
【図５】



【図８】



【図７】



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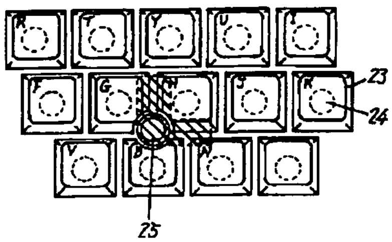
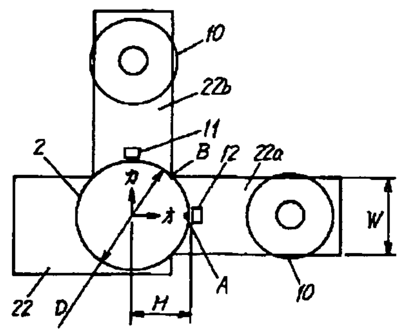
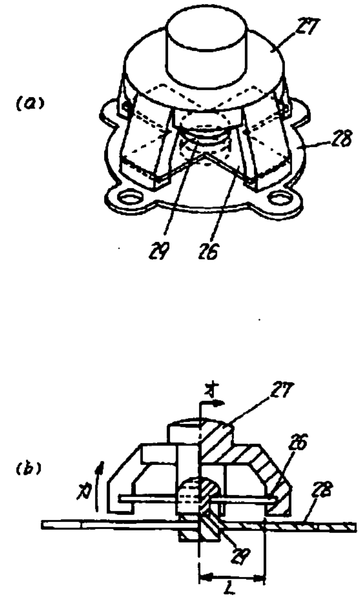


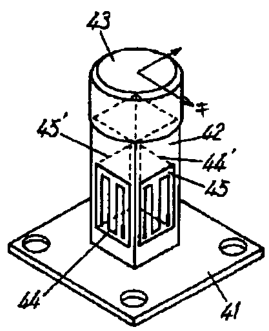
【図10】



【図11】



【図12】



LOAD SENSOR

Patent Number: JP7174646
Publication date: 1995-07-14
Inventor(s): HARADA YUTAKA; others: 02
Applicant(s): MATSUSHITA ELECTRIC IND CO LTD
Requested Patent: JP7174646
Application Number: JP19940236905 19940930
Priority Number(s):
IPC Classification: G01L1/22; G01G3/14; G01L5/00; G06F3/033
EC Classification:
Equivalents: JP3039286B2

Abstract

PURPOSE:To provide a load sensor which is excellent in resistance accuracy, cost, mass productivity, reliability and strength regarding the load sensor which is used as a pointing device.
CONSTITUTION:In an elastic plate 1, its circumference is fixed at four places, and a glass enamel coating is formed. The elastic plate 1 is deformed by a force which is applied to an operating part 2 which is erected in the center of the elastic plate 1. Its deformation is detected on the basis of a change in resistance values of two pairs of resistance detection elements 5, 5', 6, 6' which have been formed directly on the enamel coating, and the difference in the change between individual pairs of resistance values is operated. Thereby, the direction and the magnitude of the force in the operating part are detected.

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(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD

(72)Inventor : HARADA YUTAKA
KAMEI MAKOTO
JITOSHO NORIYUKI

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(54) LOAD SENSOR

(57)Abstract:

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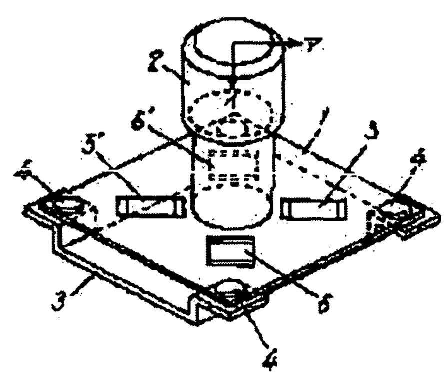

the magnitude of the force in the operating part are detected.

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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The load sensor which consists of the elastic plate which has a fixed part at the edge, a control unit arranged in the center of this elastic plate, and at least two distortion resistance sensing elements prepared on the aforementioned elastic plate.
[Claim 2] The elastic plate which has a fixed part in the center, the control unit prepared in the edge of this elastic plate, and the load sensor which consists of at least two distortion resistance sensing elements on the aforementioned elastic plate.
[Claim 3] The load sensor which consists of a L character-like elastic plate, the glass hoe low enveloping layer prepared on this elastic plate, the control unit stood in the center of the aforementioned elastic plate, the supporter of the center of the aforementioned elastic plate, a supporter equipped with the aforementioned elastic plate, and at least two distortion resistance sensing elements directly formed on the hoe low.
[Claim 4] An elastic plate is a load sensor according to claim 3 considered as the PIPOTTO support which regulates movement perpendicular to a metal elastic-plate flat surface although it is fixed in all the directions and a central supporter can be rotated with a supporter.
[Claim 5] The load sensor according to claim 4 characterized by having arranged other two distortion resistance sensing elements which become two distortion resistance sensing elements and pairs to the extension outside the supporter of the circumference of an elastic plate.
[Claim 6] It is the load sensor according to claim 1 or 3 characterized by considering as the PIPOTTO support which regulates the movement of a metal elastic-plate flat surface and a perpendicular direction although it could presuppose that only the direction of the supporter of an elastic plate to which the supporter of the center of an elastic plate and the circumference is connected is movable and the central supporter could be rotated.
[Claim 7] A distortion resistance sensing element is a load sensor according to claim 1, 2, or 3 which is a distortion induction resistor.
[Claim 8] An elastic plate is a load sensor according to claim 1, 2, or 3 which consists the electrical insulation material of the substrate which consists of piezoelectric material, glass, or a resin of any of the metal plate which coated at least the part, a hoe low metal plate, the substrate which consists of an alumina, the substrate which consists of resin material, or a copper clad laminate.
[Claim 9] The load sensor according to claim 1, 2, or 3 arranged to the position of symmetry of the line which has two pairs of distortion resistance sensing elements on the same front face of an elastic plate, and intersects perpendicularly with two pairs of these distortion resistance sensing elements.
[Claim 10] The load sensor according to claim 1, 2, or 3 which has two pairs of distortion resistance sensing elements, and arranges a pair each of distortion resistance sensing elements on the front reverse side which becomes the field symmetry of an elastic plate.
[Claim 11] The load sensor according to claim 4 which comes it larger than the width of face of the aforementioned elastic plate to carry out [the diameter of the aforementioned control unit] the diameter of the control unit which it comes to connect with an elastic plate.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the load sensor used for the pointing device which performs a two-dimensional coordinate input.
[0002]
[Description of the Prior Art] In recent years, the pointing device attracts attention as an important input as a two-dimensional coordinate input and an operation input unit of GUI (graphical user interface), such as a personal computer (it is hereafter described as a "personal computer".). A notebook personal computer comes to be widely used from the flow of small and lightweight-izing of a personal computer, and the "mouse" is extensively used as one of the pointing device of this. However, a notebook personal computer is placed not only a desk top but on a knee, or use in the place which cannot secure the flat surface for operating mice, such as seats, such as a train and an airplane, increases, and in order for the mouse to be a pointing device with a use top problem and to solve this technical problem, the pointing device which used the load sensor is developed.
[0003] Below, the pointing device using the conventional load sensor is explained. Drawing 12 is the perspective diagram of the pointing device using the conventional load sensor. In drawing 12 , 41 is a mount. 42 is the shaft of four prismatics prepared in the center section of the mount 41 at one, and the upper surface has the control unit 43 which gives a load with a finger. It has 2 to 1st and 2nd strain gage 44, 44', 45, and 45', and it is the force applied to the control unit 43, a shaft 42 deforms by component of a force perpendicular to a shaft 42, 1st, 2nd strain gage 44, 44', 45, and 45' contracts according to this deformation, and resistance changes. [which were stuck so that the side of this shaft 42 might become the field and pair which counter]
[0004] That is, since 1st, 2nd strain gage 44, 44', 45, and 45' makes the couple the medial axis of a shaft 42, and 1 symmetrical set and this 2 to 1st and 2nd strain gage 44, 44', 45, and 45' is arranged in the interval of 90 degrees, deformation of a shaft 42 can be divided into two coordinates. The signal which took the difference of the signal of the 1st strain gage 44 and the strain gage of the couple of 44' is made into the signal of the direction of 1 axis of coordinates in fact, and the 2nd strain gage 45 and 45' take the signal of a difference similarly, and make it the signal of other axes of coordinates.
[0005] With the above-mentioned signal of two axes of coordinates, a finger detects the direction and size of the force which were given to the control unit 43, and serves as a signal to which the pointer on CRT (not shown) is moved.
[0006]
[Problem(s) to be Solved by the Invention] With the above-mentioned conventional composition, since 1st, 2nd strain gage 44, 44', 45, and 45' is pasted up on the shaft 42 Since the direction which the sensitivity to the force applied to the control unit 43 of the upper surface of a shaft 42 changes, and a pointer moves will change if the position to paste up shifts, while having to position with a sufficient precision It had the technical problem that it was necessary to take the adhesion method which is not made to transform 1st, 2nd strain gage 44, 44', 45, and 45' at the time of adhesion.

[0007] Furthermore, while making the same the resistance of 1st [of the side in which a shaft 42 counters], 2nd strain gage 44, 44', 45, and 45', it had the technical problem that had to sort out and use it, became a cost rise, and assembly became complicated.
[0008] this invention solves the above-mentioned conventional technical problem, and aims at offering the load sensor which was excellent in the low cost at mass-production nature.
[0009]
[Means for Solving the Problem] In order to solve a technical problem conventionally [above-mentioned], this invention consists of the elastic plate which has a fixed part at the edge, a control unit arranged in the center of this elastic plate, and at least two distortion resistance sensing elements prepared on the aforementioned elastic plate.
[0010] Moreover, it becomes the elastic plate which has a fixed part in the center, and the control unit prepared in the edge of this elastic plate from at least two distortion resistance sensing elements on the aforementioned elastic plate.
[0011]
[Function] Therefore, since a distortion resistance sensing element is directly formed in an elastic plate by methods, such as thick film screen printing, according to this invention, there is no position gap by adhesion like a Prior art, and a distortion resistance sensing element can be collectively arranged with a sufficient precision.
[0012] Moreover, since it is distorted on the glass hoe low coat on a metal plate and a resistance sensing element is formed, relative-resistance precision is high, trimming is easy, and high institutionalization of resistance is possible.
[0013]
[Example]
(Example 1) Below, the pointing device using the load sensor in one example of this invention is explained.
[0014] Drawing 1 is the perspective diagram of the pointing device using the load sensor in one example of this invention. In drawing 1 , 1 is an elastic plate and consists the electrical insulation material of the substrate which consists of piezoelectric material, glass, or a resin of any of the metal plate which coated at least the part, a hoe low metal plate, the substrate which consists of an alumina, the substrate which consists of resin material, or a copper clad laminate. 2 is the control unit which connected with this elastic plate 1 and was prepared in the abbreviation center section of the elastic plate 1. 3 is a mount, and it is fixed by the fixed part 4 which is an edge around [four] an elastic plate 1, and it has structure which an elastic plate deforms for a control unit 2 by applying the force with a finger. Between the control unit 2 on an elastic plate 1, and the fixed part 4, 1st [which becomes a control unit 2 and the position which counters, i.e., the position of symmetry the position of symmetry and the line which connects a fixed part 4 and a control unit 2 on the same front face of an elastic plate 1 cross at right angles, from the equal distortion induction resistor of resistance], 2nd distortion resistance sensing-element 5, 5', 6, and 6' is prepared.
[0015] Operation of the pointing device using the load sensor in one example of this invention constituted as mentioned above is explained below.
[0016] First, when the force is applied in the direction of "A" parallel to the elastic plate 1 which shows a control unit 2 to drawing 1 , the portion of the 1st distortion resistance sensing element 5 of an elastic plate 1 deforms into a concave surface, and the portion of 1st distortion resistance sensing-element 5' deforms into a convex. By this deformation, the resistance of the 1st distortion resistance sensing element 5 falls, and the resistance of 1st distortion resistance sensing-element 5' goes up. By calculating the difference of the change in resistance of the couple of this 1st distortion resistance sensing element 5 and 5', a change in resistance is expanded to double precision, and the applied force can be detected.
[0017] On the other hand, a change in resistance does not happen only by the torsional stress of the same direction being applied, as for the 2nd distortion resistance sensing element 6 and 6'. That is, the force of only the 1st distortion resistance sensing element 5 and the direction of an axis of coordinates on 5' is detectable.

[0018] Next, when the force is applied in the direction of "I" parallel to the elastic plate 1 which shows a control unit 2 to drawing 1 , the torsional stress of the same direction is applied to a concave surface, and, as for the portion of the 2nd distortion resistance sensing element 6 of an elastic plate 1, the 1st distortion resistance sensing element 5 and 5' can detect the force of only the 2nd distortion resistance sensing element 6 and the direction of an axis of coordinates on 6' on it at a convex, as for the portion of 2nd distortion resistance sensing-element

[0019] Thus, it dissociates in the direction of two axes of coordinates, and the force applied to the control unit 2 can detect a direction and a size.

[0020] (Example 2) Drawing 2 is a pointing device using the load sensor in the example 2 of this invention, the same composition as an example 1 attaches the same number, and explanation is omitted. A different place from an example 1 is having arranged the 1st distortion resistance sensing element 5 which becomes a pair, 5' and the 2nd distortion resistance sensing element 6, and 6' on the front reverse side of an elastic plate 1. In this example 2, 1st [which becomes a pair], 2nd distortion resistance sensing-element 5, 5', 6, and 6' receives deformation of compression and extension to distortion of an elastic plate, and its detection precision improves.

[0021] (Example 3) Drawing 3 is a pointing device using the load sensor in the example 3 of this invention, the same composition as an example 1 attaches the same number, and explanation is omitted. An example 3 is what changed the configuration of the elastic plate 1 of an example 1, uses an elastic plate 7 as the cross-joint type centering on a control unit 2, and fixes four places of an edge by the fixed part 4. In this example 4, since it becomes easy to generate distortion equally while sensitivity of the signal change to the force is made highly, since it becomes larger than the examples 1 and 2 which the deformation of the elastic plate 7 to the applied force mentioned above, high degree of accuracy is not required of the position precision of the 1st and 2nd distortion resistance sensing element, but productivity becomes high.

[0022] (Example 4) Drawing 4 and drawing 5 are the examples 4 of this invention, and, as for the L character-like elastic plate in which, as for 8, glass hoe low covering was prepared, and 2, a control unit and 9 are mounts. 13 is the salient from a mount 9 in a PIPOTTO supporter. The center of an elastic plate 8 is connected with a control unit 2, and two places of the circumference are being fixed by the fixed part 10 of a mount 9. Moreover, the center of an elastic plate 8 is supported with the PIPOTTO supporter 13 from a mount 9. Furthermore, in the glass hoe low covering surface of elastic-plate 8 front face, the 1st of 11 and 12 and 2nd distortion resistance sensing element carries out the printing coat of the glaze resistance, and constitutes it directly.

[0023] If operation is explained below, when the force is applied in the direction of "U" on drawing 4 (parallel to an elastic plate 8), the portion of the 2nd distortion resistance sensing element 12 of a metal elastic plate will deform a control unit 2 into a concave surface. On the other hand, the portion of 11 deforms by twisting by PIPOTTO support. Although it is distorted by deformation of the portion of this 2nd distortion resistance sensing element 12 and, as for a resistance sensing element, resistance changes, there is no change in resistance of the 1st 11 distortion resistance sensing element only by torsional stress being applied. Next, when the force is applied in the direction of "E" on drawing 4 (parallel to an elastic plate 8), the portion of the 1st distortion resistance sensing element 11 of an elastic plate 8 deforms a control unit 2 into a concave surface, and as for the 2nd distortion resistance sensing element 12, torsional stress is applied. Thus, it dissociates in the direction of two axes of coordinates, and the force applied to the control unit 2 can detect a direction and a size.

[0024] Moreover, in this example 4, since support of PIPOTTO 13 receives a normal load, only a horizontal load can be detected correctly and the pointing device using the load sensor which was excellent in operability can be offered.

[0025] (Example 5) Drawing 6 is distorted and is other examples of arrangement of a resistance sensing element. The 1st, the 1st which become the 2nd distortion resistance sensing element 11 and 12 and a pair, and 2nd distortion resistance sensing-element 11'12' is arranged on the outside of the fixed part 10 which extended the elastic plate 14. The 1st in this position, distortion resistance sensing-element 11of ** 2nd ', and 12' are not influenced although an elastic plate 14 is distorted. each of the 1st distortion

resistance sensing element 11 which becomes a pair in this example 5, 11' and the 2nd distortion resistance sensing element 12, and 12' -- the difference of resistance change is calculated It can be distorted by this and the temperature change of a resistance sensing element can be canceled.
[0026] (Example 6) Drawing 7 (a) and (b) are the examples 6 of this invention, and show a cross section. For 15, as for a susceptor and 17, an elastic plate and 16 are [a mount and 18] control units. A control unit 17 and an elastic plate 15 are one, and have established the cone-like crevice 19 in the central bottom of a control unit 18. From the susceptor 16, the PIPOTTO supporter 20 which is a cone-like salient was formed, and it is in contact with the crevice 19 of a control unit 18. Since it is such support, although a control unit 18 can rotate freely the nose of cam of the height 20 of a susceptor 16 as a center, even if a control unit 18 is pressed down in the susceptor 16 direction, it is supported with the PIPOTTO supporter 20 of a susceptor 16.
[0027] Although 21 has sandwiched the elastic plate 15 with the supporter of the elastic-plate 15 circumference of a susceptor 16 and a mount 17, suitable path clearance is given to the thickness of an elastic plate 15. Furthermore, the supporter 21 of an elastic plate 15 and a mount 17 has opened the hole of an ellipse in the elastic plate 15, as shown in drawing 7 (b), and the pillar-like salient has entered from the mount 17. Since it is such structure, an elastic plate 15 can slide freely only the line top which connects a supporter 21 to the center of a control unit 18.
[0028] In addition, the drawing top is omitted, although it is distorted like the elastic-plate 14 top of an example 5 to an elastic plate 15 and the resistance sensing element is prepared.
[0029] According to the force applied at control unit 18 nose of cam also in this example, it is the same as that of other examples that an elastic plate 15 deforms, and it has a function as a load sensor. In this example, a control unit 18 accepts it crevice 19, it comes out, and the fixed part in a direction parallel to the field of an elastic plate 15 has the structure where it is not influenced of the expansion and contraction by the temperature of a certain shell susceptor 16 and mount 17.
[0030] (Example 7) Drawing 8 is distorted in the 3rd arm section which does not have a fixed part 10 considering the elastic plate of drawing 6 of an example 4 as a T character-like elastic plate 22, and arranges 12" 11" of resistance sensing elements. It is the same as that of an example 4 not to receive 12" of stress 11" of distortion resistance sensing elements. In this example, a circuit pattern 22 does not need to let it pass near the fixed part 10, the arm section is made thinly and the miniaturization of it is still attained.
[0031] Drawing 9 shows the application which used drawing 4 and the load sensor of this invention of drawing 5 as a pointing device of a full keyboard, and, as for a keytop and 24, 23 is [SW element and 25] the load sensors of examples 4 and 5. As the dashed line showed under each keytop 23, the SW element 24 is arranged, and the load sensor 25 shown by hatching is installed among these SW elements 24. Even if a sensor becomes large, a L character configuration has between keys the feature which can be arranged well after this, so that clearly. The same is said of the T character configuration. For this reason, it can contribute to the further miniaturization of the notebook computer which built in the pointing device.
[0032] Drawing 10 is drawing in which having been distorted with the elastic plate and shaft in the examples 4-6 of the pointing device using the load sensor in this invention, and having shown the relation with a resistance sensing element. If the pointing device of an example 6 is made into an example and explained here, the diameter of the connection section of the elastic plate 22 connected with the control unit 2 will be set to D. Width of face of the arm sections 22a and 22b which have arranged the distortion resistance sensing elements 11 and 12 on an elastic plate 22 is set to W. Distance to distortion resistance sensing-elements 11 and 12 and control unit 2 center is set to H.
[0033] If a horizontal load is added in the direction of "O" of a control unit 2 at this time, arm section 22a which allotted the distortion resistance sensing element 12 of an elastic plate 22 will receive bending stress. If bending stress is applied to the elastic plate 22 connected with the control unit 2 which a control unit 2 is the rigid body and is this rigid body at this time, since the boundary section of a control unit 2 and an elastic plate 22 will receive the maximum stress, the intersection A of the medial axis of arm section 22a and the periphery of a control unit 2 will receive the maximum stress. This intersection

A is H=0.5D.
[0034] It pulls as it separates from a medial axis, on the other hand, since arm section 22b has received torsional stress at this time, it pulls, as stress, the medial axis of arm section 22b is 0 in the neutral point, stress becomes large, it is arranging on the medial axis of arm section 22b, and the distortion to torsional stress serves as the minimum. It is the maximum to bending stress in it being distorted from such stress distribution and arranging the resistance sensing elements 11 and 12 near H=0.5D on the medial axis of the arm sections 22a and 22b, and the minimum signal is acquired to torsional stress.
[0035] That is, by this example 6, although the neutral point serves as a medial axis of a rectangular elastic plate when torsional stress is applied to a rectangular elastic plate, since torsional stress is applied to arm section 22a of one side of the T character-like elastic plate 22, as for the neutral point, a medial-axis top does not become in response to the influence of distortion of the bending stress of arm section 22b of another side. What is necessary is to make thick the diameter of the control unit 2 which is the rigid body, and just to make it distortion not get across to the two arm sections 22a and 22b, in order to carry out the neutral point on a medial axis. That is, the periphery of the connection section of a control unit 2 and an elastic plate 22 is carried out more than the diameter which laps with an intersection (B point of drawing 10) with the side outside the two arm sections 22a and 22b. That is, [0036]
[External Character 1]
$\sqrt{2W}$

[0037] Influence of torsional stress is made small by carrying out, and an error signal serves as the minimum. Thus, by specifying the position of a distortion resistance sensing element, the diameter of a control unit 2, and the size of the arm sections 22a and 22b, an error can be made into the minimum and the horizontal load added to the control unit 2 can be divided into two shafts.
[0038] (Example 8) In the example 8 of the pointing device using the load sensor [in / this invention / in drawing 11 (a) and (b)], drawing 11 (a) is a perspective diagram and drawing 11 (b) is a cross section. As for a control unit and 28, as for a mount and 29, 26 is [an elastic plate and 27] fixed parts in this example. An elastic plate 26 is fixed by the fixed part 29 of a mount 28 in a center, and the control unit 27 is connected with the circumference of an elastic plate. If the force can be applied for control unit 27 nose of cam like a load "O", an elastic plate 26 will apply and deform stress in the direction of the force to the center. It has structure contrary to the example of drawing 1 -3 by this example 8, and the center of an elastic plate 26 has received the load from a control unit 27 in the periphery by fixation.
[0039] In this example 8, the position (L of drawing 11 (b)) where a control unit 27 applies stress to an elastic plate 26 is able to make it longer than examples 4-6. Since the nose of cam of a control unit 27 is made into the configuration which is easy to operate the nose-of-cam configuration in the portion to which a fingertip hits, a resin cast will be used. In this example 8, since L size is long, the stress of the portion combined with the elastic plate becomes small, and since deformation of a resin is small and the point of application into which an elastic plate is made to transform is stable, change of the deformation of the elastic plate by temperature decreases.
[0040] Moreover, while it is tough to external stress or a shock by using a hoe low metal plate or a glass coat metal plate for an elastic plate, erector methods, such as a caulking, can be used and assembly becomes easy. Moreover, since high temperature processing is possible, a highly reliable metal glaze resistor can be used for a resistor.
[0041]
[Effect of the Invention] Since this invention arranges the distortion resistance sensing element on a flat surface, it can arrange a distortion resistance sensing element with a sufficient precision collectively, its relative precision of resistance is high, it is being distorted at a flat surface by methods, such as thick film screen printing, and forming a resistance sensing element, and highly-precise-izing of resistance is [trimming is also easy this invention and] possible for it. In the example which only the whole surface was especially distorted and formed the resistor, this feature is remarkable. Moreover, since a glass hoe low is made into an insulating layer, a metal glaze resistor [that high temperature processing is possible and high-reliability] can be used. There is the feature from which a tough thing and erector methods,

such as a caulking, can be used to using-furthermore-metal elastic plate shell external stress or a shock, and assembly becomes easy. A thick-film hybrid integrated circuit can also be constituted on glass hoe low covering as other features.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] *In recent years, the pointing device attracts attention as an important input* as a two-dimensional coordinate input and an operation input unit of GUI (graphical user interface), such as a personal computer (it is hereafter described as a "personal computer".). A notebook personal computer comes to be widely used from the flow of small and lightweight-izing of a personal computer, and the "mouse" is extensively used as one of the pointing device of this. However, a notebook personal *computer is placed not only a desk top but on a knee, or use in the place which cannot secure the flat* surface for operating mice, such as seats, such as a train and an airplane, increases, and in order for the mouse to be a pointing device with a use top problem and to solve this technical problem, the pointing device which used the load sensor is developed.
[0003] Below, the pointing device using the conventional load sensor is explained. Drawing 12 is the perspective diagram of the pointing device using the conventional load sensor. In drawing 12 , 41 is a mount. 42 is the shaft of four prismatics prepared in the center section of the mount 41 at one, and the upper surface has the control unit 43 which gives a load with a finger. It has 2 to 1st and 2nd strain gage 44, 44', 45, and 45', and it is the force applied to the control unit 43, a shaft 42 deforms by component of a force perpendicular to a shaft 42, 1st, 2nd strain gage 44, 44', 45, and 45' contracts according to this deformation, and resistance changes. [which were stuck so that the side of this shaft 42 might become the field and pair which counter]
[0004] That is, since 1st, 2nd strain gage 44, 44', 45, and 45' makes the couple the medial axis of a shaft 42, and 1 symmetrical set and this 2 to 1st and 2nd strain gage 44, 44', 45, and 45' is arranged in the interval of 90 degrees, deformation of a shaft 42 can be divided into two coordinates. The signal which took the difference of the signal of the 1st strain gage 44 and the strain gage of the couple of 44' is made into the signal of the direction of 1 axis of coordinates in fact, and the 2nd strain gage 45 and 45' take the signal of a difference similarly, and make it the signal of other axes of coordinates.
[0005] With the above-mentioned signal of two axes of coordinates, a finger detects the direction and size of the force which were given to the control unit 43, and serves as a signal to which the pointer on CRT (not shown) is moved.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The perspective diagram of one example of the load sensor of this invention
[Drawing 2] The perspective diagram of the example of ****
[Drawing 3] The perspective diagram of the example of ****
[Drawing 4] The perspective diagram of the example of ****
[Drawing 5] This side elevation
[Drawing 6] The perspective diagram of the example of ****
[Drawing 7] (a) The sectional side elevation of an example besides **
(b) The up cross section of this important section
[Drawing 8] The perspective diagram of the example of ****
[Drawing 9] The plan explaining the keyboard using the load sensor of this invention
[Drawing 10] The plan of this important section
[Drawing 11] (a) The perspective diagram of an example besides **
(b) This side elevation and a cross section
[Drawing 12] The perspective diagram of the conventional load sensor
[Description of Notations]
1 15 Elastic plate
2, 18, 27 Control unit
3, 9, 17, 28 Mount
4, 10, 29 Fixed part
5 5' 1st distortion resistance sensing element
6 6' 2nd distortion resistance sensing element
7 26 Cross-like elastic plate
8 14 Elastic plate of a L character configuration
11 11' 1st distortion resistance sensing element
11 or 11" 1st distortion resistance sensing element
12 12' 2nd distortion resistance sensing element
12 or 12" 2nd distortion resistance sensing element
13 20 PIPOTTO supporter
21 Slide Supporter
22 Elastic Plate of T Character Configuration
23 Keytop
24 SW Element of Keyboard
31 Cross Section is Square Shaft.
32 32' Strain gage of a couple
33 and 33' others -- strain gage of a couple

[Translation done.]

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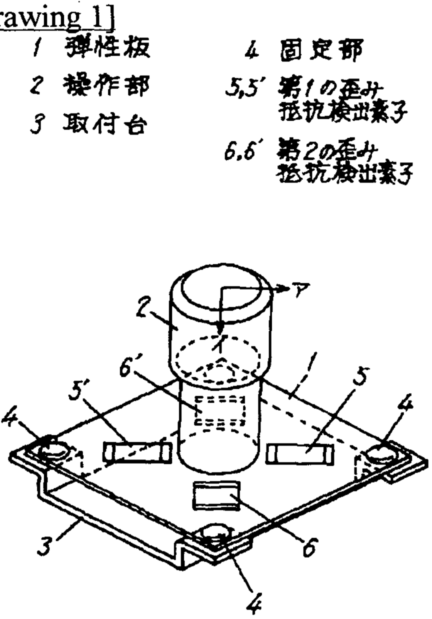
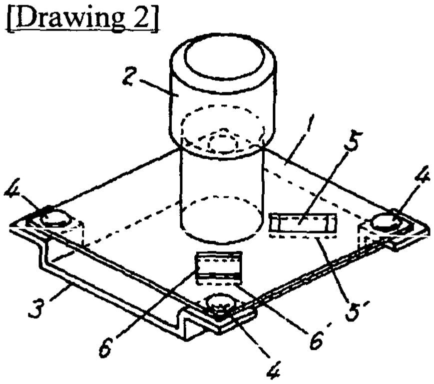
DRAWINGS

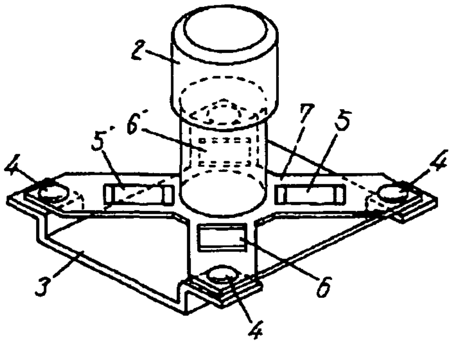
[Drawing 1]



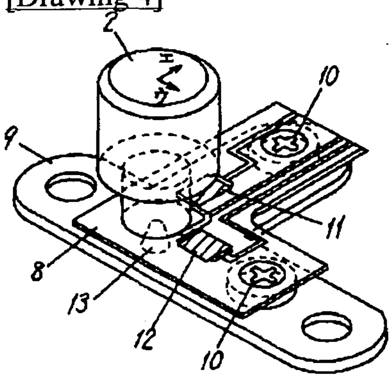
[Drawing 2]



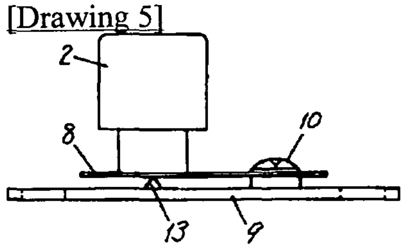
[Drawing 3]



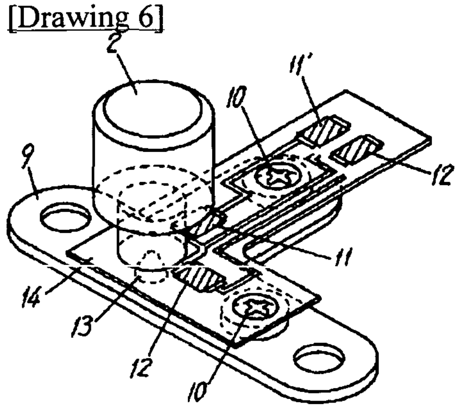
[Drawing 4]



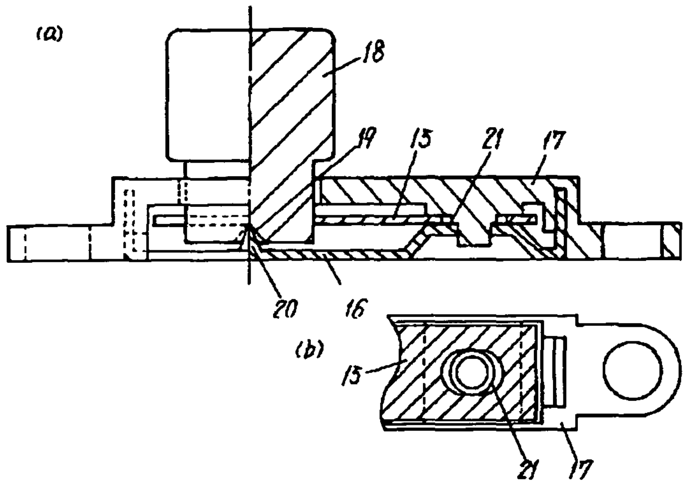
[Drawing 5]



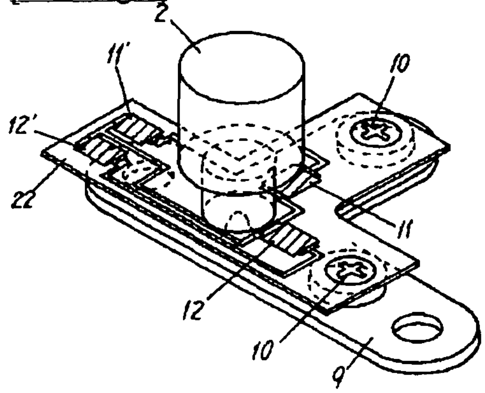
[Drawing 6]



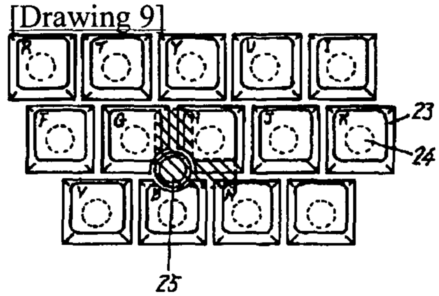
[Drawing 7]



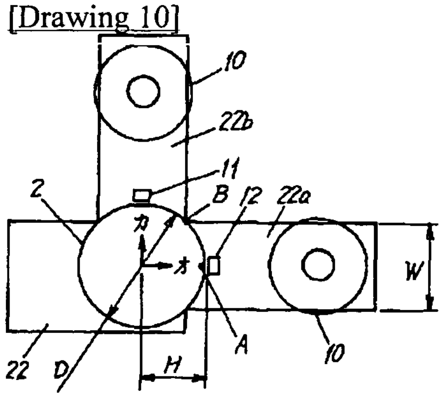
[Drawing 8]



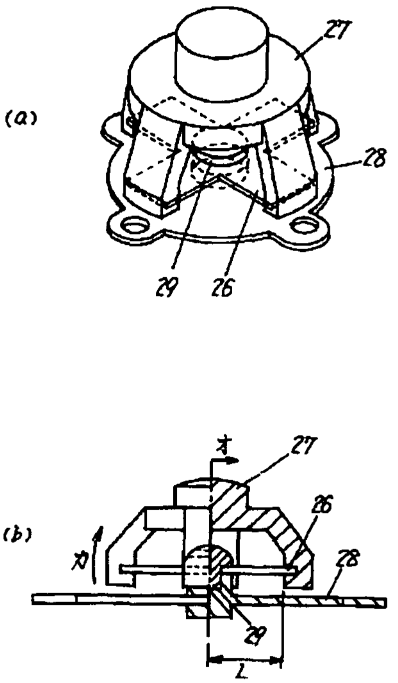
[Drawing 9]



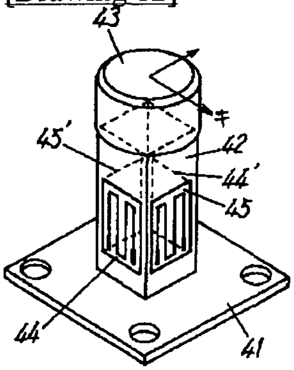
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]